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THE IMPROVEMENTS OF PERSONAL HEALTH INFORMATION SYSTEM WORKING WITH CLOUD COMPUTING

Abstract: There are rare cases when people address specialists on time if they have a disease or a routine examination or go to the same hospital. This creates a problem of incomplete indicators about the patient, since the stored information in hospitals is rarely synchronized with each other. This article discusses the use of cloud technologies in medicine. The research examined two systems for storing medical data: a lifetime medical record system and a system where a smartphone fulfills the function of a personal healthcare system using cloud storage. In order to expand the stored medical data about patients and expand the functionality of the systems, a number of measures were proposed for the improvement. Thus, for every person a whole database of information is formed, which allows specialists to monitor the human state and predict diseases.

Keywords: medical indicators, medical diagnostics, cloud technologies, biological indicators, disease prevention.

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УЛУЧШЕНИЯ ИНФОРМАЦИОННОЙ СИСТЕМЫ ЛИЧНОГО ЗДОРОВЬЯ, ИСПОЛЬЗУЮЩЕЙ ОБЛАЧНЫЕ ВЫЧИСЛЕНИЯ

Аннотация: Редки случаи, когда люди обращаются вовремя к специалистам при возникновении какого-либо заболевания или на обычный осмотр, или в одно и то же лечебное учреждение. Это создает проблему неполноты показателей о пациенте, так как хранимая информация в больницах редко синхронизируется друг с другом. В данной статье рассматривается применение облачных технологий в медицине. В ходе были рассмотрены две системы по хранению медицинских данных: система пожизненных медицинских карт и система, где смартфон представляет собой личную систему здравоохранения с использованием облачного хранилища. С целью расширения хранимых медицинских данных о пациентах и расширения функционала систем был предложен ряд мер по их улучшению. Таким образом, на каждого человека формируется целая база информации, которая позволяет специалистам мониторить состояние человека, предугадывать заболевания.

Ключевые слова: медицинские показатели, медицинская диагностика, облачные технологии, биологические показатели, профилактика заболеваний

Cloud computing is the technology of distributed data processing in which computer resources and capacities are provided to the user as an Internet service. Cloud computing can be used in the form of Storage-as-a-Service (SS). This is the simplest of the SS services which presents disk space on demand. Storage-as-a-Service allows storing data in an external storage, in a «cloud».

Database-as-a-Service provides the ability to work with databases as if the database was installed on a local resource, helping to save computer power and licenses required for the proper use of the database in a large or even medium-sized organization. Information-as-a-Service allows people remotely use any kind of information that may be changed every minute or even every second.

Cloud computing helps to save resources and increase the productivity of enterprises, so the development and design of new ways of their applications are useful for a society. Moreover, particular attention should be paid to the health system. According to the latest surveys, only a small part of Russian population seeks medical advice at the first signs of discomfort. The reason for this phenomenon is lack of time, distrust of doctors and long queues in hospitals. As a result, people go to private clinics or other health care facilities. Patients' data is often stored in paper form and is not synchronized between different health facilities. Therefore, the problem is the incompleteness of data about the patient and their medical history. The purpose of this article is to study the system with the use of cloud technologies in medicine for storing patient data and propose measures for improvements.

To achieve this goal, the existing methods of patient data storage were studied, the existing systems were analyzed, their shortcomings were identified, a number of measures were developed to improve data storage systems and prospects for development in scaling were found.

Literature review

According to the results of the research, the industry that had the largest expenditure on cloud computing in 2018 was health care, where the amount of $12.1 billion was spent on the relevant services.[4] In their article, Pieter Van Gorp and Marco Comuzzi describe one of the technologies of cloud application in medicine: lifelong storage of personal data of patients in the cloud (MyPHRMachines), using the technology «database as a service». [1] Thus, a personal medical card of the patient is formed and cannot be lost. The use of technology allows restoring the full history of the patient's diseases and makes it available from a conventional smartphone at any time. The results of the analysis and the snapshot can be viewed using special software without installing it on the device. It is proposed to include in the patient's medical record only the results of examinations and analyses carried out in medical institutions excluding daily human indicators.

The introduction of a complete personal information system for the storing of human data in cloud computing was proposed by Wan-Young Chung and Ee May Fong [3]. The study is based on the technology of non-contact ECG measurement integrated with the mobile system. Experiments have shown that heart rate measurements conducted with the usage of the new device are quite accurate and do not differ from those which are made on a conventional ECG device in a hospital. The experiment involved men and women aged 21-52. In that case smartphone was used as a personal health information system that displayed the state of human health, body mass index, a reminder of medication and doctor's appointments. The patient's health data is transmitted to the cloud data storage, which is accessible to the patient, their relatives and medical staff, the data is provided in keeping with the patient. This system allows remote monitoring of the health state which contributes to the effective use of the personal health system. The implementation of such systems is really useful and necessary as it will reduce the rates of disease recurrence and help to prevent them. At the same time, patient's relatives can be constantly in contact with them, find out if a disease has repeated and respond timely. The mobile health system is a good invention but it is open for improvements. The full functionality of the system will not only inform about the state of the person but present the information about the whole regions.

Adding a number of functions to the application will increase its usefulness and allow extension for a large target audience, increase the population base and the expansion. It is necessary for the patient to add the ability of entering information individually about daily routine. Thus, keeping records about the amount of consumed water, activity, amount of food (calories) and general condition of a person will allow prediction what diseases they may be exposed to. For example, detect diabetes or depression at an early stage. Analyzing the daily indicators of a person and their activity, the system can give advice on one’s health, which a person will follow and take care of personal health or finally decide to see a doctor for a consultation. To get more accurate data, such as heart rate, body temperature, it is possible to wear a bracelet, a heart rate monitor, which is integrated with the main system. It does not change the usual way of a patient’s life while providing relevant and accurate information. Measuring the anomalies, the system sends an alert to the person who has been chosen as an authorized representative of a patient. Deviations from the norm are written as an electronic medical record of the patient

application MyPHRMachines in a separate section, which is also stored in the cloud service. This will allow physicians to predict the consequences of the disease and their dynamics more accurately.

The introduction of the new functionality is also focused on ordinary people who do not suffer from acute diseases. Due to the statistics of the application, based on the results of the patient's tests, a person can track the overall health. On the basis of the collected data it is possible to create medical geographic information systems for monitoring diseases of a region or city. According to the obtained data, it will be possible to determine the lack of specialists in any region or redistribute resources. In comparison with the existing methods, access to relevant data will be fast, it will be possible to monitor the disease level of population in real time and provide additional resources timely in case of exacerbation of a disease or epidemic.

Combining two principles of the above systems will ensure the long-term storage of patient data, his medical history, as well as the integrity of information about the diagnosis and daily health of the patient.

Results

The introduction of additional functionality in the mobile medical system will increase the importance of the application and expand its area of implementation. It will reduce the stroke risk of people suffering from chronic diseases. The spread of such systems will remind people to take care of their health and contact doctors in time. The introduction of additional gadgets, such as a separate heart rate monitor and thermometer will achieve the most accurate measurements. The integration of the mobile health system and the MyPHRMachines cloud-based electronic health card system will improve the quality of health care and predict the development or treatment of diseases. Having a full history of medical patient indications doctors will be able to identify the causes of the disease more accurately and quickly. Moreover, Geo-information maps created on the basis of information will clearly show the real state of health of the population in the region.

Thus, in this paper we have described two systems for the collection and storage of personal medical data of the person: MyPHRMachines and personal health systems. Combining the functionality of these applications and a number of measures to improve them will expand the functionality provided and ensure the completeness of the patient's medical data. The new system of data collection and storage can not only dynamically monitor the information related to health at any time, but also act as a

medical assistant: remind about the time of medication, doctor's appointments, warn against possible diseases. ECG results, General indicators, information entered by a person, location data are controlled by a mobile device that is synchronized with the cloud storage. The information can be viewed by the attending physician, who can immediately give recommendations. The introduction of such systems in the near future will automate the processes of the health care system and can be applied to all the inhabitants of the planet, primarily to people suffering from cardiovascular diseases.

REFERENCES

1. Pieter Van Gorp, Marco Comuzzi// Lifelong Personal Health Data and Application Software via Virtual Machines in the Cloud, 2015. – P.1 – 6; [Электронный документ] URL: https://ieeexplore.ieee.org/document/6497445 (23.12.2018).

2. Robert Woitsch, Wilfrid Utz// Business Process as a Service: Model Based Business and IT Cloud Alignment as a Cloud Offering, 2016. – P.121 – 130; [Электронный документ] URL: https://ieeexplore.ieee.org/document/7406854 (23.12.2018).

3. Wan-Young Chung, Ee May Fong // Seamless personal health information system in cloud computing, 2014. – P.3658 – 3661; [Электронный документ] URL: https://ieeexplore.ieee.org/document/6944416 (23.12.2018).

4. Облачные вычисления (мировой рынок) [Электронный документ] URL: http://www.tadviser.ru/index.php/IDC:_.D0.BE.D1.82.D1.80.D0.B0.D1.81.D0.BB.D0.B8_.D1.81_.D1.81.D0.B0.D0.BC.D1.8B.D0.BC.D0.B8_.D0.B1.D0.BE (23.12.2018).